



Saving blue gold – methods and solutions

Abhilaksh Grover¹, Adwiteya Grover², Alka Sharma Grover³✉

1. Advocate, Supreme Court, New Delhi, Punjab and Haryana High Court, Chandigarh, India

2. B.A. LLB.(Hons.), 2nd year, Rajiv Gandhi National University of Law, Punjab, India.

3. Assistant Professor, Dept. of Chemistry, DAV College, Sector-10, Chandigarh, India; Email: India.alkachemistry@hotmail.com

✉ **Corresponding author:** Assistant Professor, Dept. of Chemistry, DAV College, Sector-10, Chandigarh, India; Email: India.alkachemistry@hotmail.com

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General Note



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ABSTRACT

Water is the most essential element for living beings on the blue planet. The world would shrink to nothing without enough water for drinking, cooking, sanitation and industrial use. As the world is advancing industrially as well as commercially, water is becoming contaminated and scarce. Need of the hour is to preserve this valuable "blue gold" and consume it judiciously. Chandigarh also known as city beautiful situated on the foothills of the magnificent Himalayas in the north western part of India is no exception as

far as the problem of water scarcity is concerned. Water auditing is a mechanism for conservation of water which will grow significantly as the demand for water increases^[1]. Water audit is also an accounting tool which determines unaccounted amount of water (UAW) in any water distribution system^[2]. An onsite survey and assessment of water wastage was undertaken through a water audit of fixtures, equipments and water management strategies at various schools, colleges, hospitals, shopping malls, open markets, houses, parks and gardens, lakes, worship places and roads of the city. The longstanding leaks, faulty fixtures and water wastage points were identified. To reduce wastage of water important recommendations were made^[3]. Lesser the use of water, lesser the utility cost. Reducing the use of water is always a profitable proposition, identifying and correcting long standing leaks will help to win half the battle of water conservation. An awareness campaign was also undertaken through human interaction during water auditing process. The findings reveal that public sector buildings such as hospitals, parks, households, educational buildings. Had leakages and a malfunctioning water system whereas their private sector counterparts had minimum or no complaints. Accountability seems to be an answer to the existing problem of wastage of blue gold and a part of strategy to save it.

Keywords: water, audit, conservation, campaign, leakage, consumption, legal

1. INTRODUCTION

Water is one of the most precious elements for life on earth. World would be unimaginable without sufficient water for drinking, sanitation, irrigation and other industry uses. However, across the world water for human consumption is getting contaminated at an accelerated speed as a result of industrial growth and indiscriminate and injudicious use. Careful consumption of water and its conservation as well as its safe guarding is highly essential for keeping life secure on earth.

Water audit is a way to activate the availability of useable water in a selective range and to utilize it in the most efficient manner. Only 0.25 per cent of the fresh water is available for human consumption and 3 per cent of total water on the earth is obtainable in the fresh form. At the same time, the rate at which water consumption increases is twice in 20 years. Shortage of water can be addressed by water auditing and other measures of caution. Water audit is thus a profitable and skillful method to assess an account of available water sources and their dispersion and wastage.

A thorough water audit can identify and specify accurate steps to be accomplished to lessen water consumption and reduce wastage of water. Water auditing also gives synopsis of water consumption from its point of entrance to the release of the water course.

In other words, the audit is meant to identify and quantify indefinable water losses and measures to be taken for wastewater management that can help administrators to go ahead with the appropriate planning and steps using water auditing.^[1]

India faces a precarious situation of water shortage, which demands desperate measures. Water resources are depleting while the demands for water from various sectors of the developing economy are rapidly rising. There is an increasing awareness around the world of the importance of water to our existence. This awareness crosses political confines and social barriers. In many countries people have no easy access to drinking water and many times it is contaminated. Importance of water audit as a tool to conserve water will grow in future as a demand of water increases significantly.^[4]

Water audits analyze water's use and identifies ways to make it more efficient. Water audit reviews indoor (domestic, sanitary) as well as outdoor (landscaping, industrial, etc.) and processed water's use and select and establish ways to increase water-use efficiency. Water audit also saves money by recommending installation of leak detection system, ultra-flow toilets, high-efficiency aerators for faucets, and flow restrictors on showerheads. A case study of the Port Authority of New York and New Jersey upgrading restroom facilities at LaGuardia Airport to increase the facility of toilets, faucets, and showers, yielded annual water savings of \$160,000 after the initial capital outlay of only \$90,000.^[5]

The energy audit proved to be the adequate mechanism effective in helping manage energy use. An energy audit helps facility executives identify and quantify what steps can be taken to reduce energy use. But even more notably, it gives a detailed survey and analysis of how energy is used within their institution. The same process is required today to reduce water use. Water use audits, like their energy counterparts, are an important first step toward understanding both a facility's water use and what can be done to reduce it. They trace water use from its point of energy into the facility through its discharge into the sewer. They identify each point of water use within and around the facility and estimate the quantity of water used as each of these points. Water audits can help identify potential uses for alternative sources of water.^[6]

A water audit is also an accounting procedure. The purpose of water audit is to accurately determine the amount of unaccounted for water (UAW) in a water distribution system.^[2]

Our objective is to assist users in cutting down precious water loss on their water distribution network through water audit on the pattern of energy audit. A case study of city Chandigarh which is a capital of the States of Punjab and Haryana, situated in the north of India, has been undertaken to assess the misuse of water through water audit. A water audit in the important institutions, parks and roads of the city was undertaken as tool for water conservation and to form the basis of the awareness campaign for proper use of water.

The Tricity of Chandigarh, Panchkula and Mohali are facing water crisis due to the low pressure of water. Chandigarh itself has a shortage of 29MGD (million gallons daily) water against availability of 87 MGD water and demand of 116 MGD. It has been estimated that the availability of ground water would be reduce by 25 MLD (million litres per day) in the next few years. According to statistical data by year 2031 there would be a shortage of 221.94 MLD in Chandigarh, UT.^[7]

Municipal Corporation of Chandigarh has tabulated various tips for conservation of water and formed Water Management Rules.^[8] Regular steps are undertaken. Tertiary water use has been encouraged to water domestic, public lawns as also golf courses. People are prohibited from using hoses for car wash and there is compulsory water rationing by limiting supply of potable water at regulated hours.

But as far as institutions; commercial centers and shopping malls are concerned, water audit was the main tool to identify leak detection both in indoor and outdoor facilities.

2. MATERIALS AND METHODS

This paper deals with water audit which is the need of the hour in the city of Chandigarh, facing water shortage especially during the summer months, accounts of data collected.

1. Started with a walk through the facility, identifying every point in which water is used. For items such as toilets and faucets, the inventory included the item, its location and its flow rate.
2. Mechanical systems account for approximately 30 percent of the total water use in an average building. For example, water storage tanks are large users of water leakages. Overflowing tanks were identified. It was necessary to use a stopwatch and a bucket to determine the actual water flow rate.
3. Irrigation systems also were significant water users. The inventory included the number of systems, the number of sprinkler heads attached to each system is equipped with ground moisture sensors to prevent activation during or immediately following a rainfall.
4. Unexplained water flow was found due to the modification of piping systems over the years, it was easy to lose track of the purpose of piping and of the equipment that was no longer in use, meters installed were also checked.
5. Proper tank and flow system was inspected.
6. Drip collection was made to estimate water wastage to following parameters.^[9] Usage of 80-100 gal/day was considered to be a satisfactory consumption.

Estimated water loss through leakages

Drips per minute	Water wasted per month	Water wasted per year
10	43 gal	526 gal
30	130 gal	1,577 gal
60	259 gal	3,153 gal
120	518 gal	6,307 gal
300	1,296 gal	15,768 gal

Factors used for conversion— $L \times 0.264 = \text{gal (gallon)}$

A sample study of schools, colleges, hospitals, shopping malls, open markets, houses, parks, and gardens, lakes, worship places and roads of the city in various corners of the city was undertaken to estimate the water use and water loss through leakage and ill maintenance of the equipment.

Awareness Campaign was carried out through human interaction during audit process and it included interacting sessions, free distribution of handouts on water saving tips, show of power point presentations on the status of water in Chandigarh, Documentary shows, questionnaire and feedback.

2.1. Legal study on water wastage through leaks

The sole legislation governing the use of water is the Water (Prevention and Control of Pollution) Act, 1974, which was enacted in response to the growing concern of disposal of industrial waste and effluents into rivers and streams meandering through major towns and cities of India. Although the enactment is yet to achieve its intended objective, a rather different yet urgent concern demands immediate attention. Wastage of water and disregard of its proper use leads to the loss of as much as 10 million gallons per day in only one city in India.^[10] The plight of a metropolis remains graver. Lack of regulation, accountability and proper penalties has encouraged theft of water.^[11] It comes as no surprise, that such theft is ignored by the authorities and dismissed as a minor leakage in the pipeline.^[12] Stranger is the fact that over the years, the authorities only seem to be contemplating a way to end such malpractices. Electricity consumption in India is regulated by the Electricity Act, 2003 and the rules contained there under.

Theft of electricity is a punishable offence with the maximum being three years of incarceration (Section 135 of the Electricity Act). Consumption of water, however is not only unregulated but the concept of unwanted wastage and leakage of water being detrimental to the long term interest of the society is alien to most people in India. The Government of India through the Ministry of Water Resources has drafted a National Water Policy ("NEP")^[13], however it remains soft law in as much as it is not binding on either the government or the citizens. The broad principle of the NEP is to treat water as an economic good to promote its conservation and efficient use. There is an urgent need to codify a policy on conservation of water and prevent its leakage coupled with a mass awareness drive to desist the citizens from wasting water. Not only must the water leakages be stopped but the same must also be recycled. Although wastage of water at this scale will at some point force the government to introduce statutory measures, however it may be too late in the day since fresh water is not a commodity that can be created.

3. RESULTS

3.1. Wastage during washing

It was observed that maximum wastage of water (Fig. 1) was during floor washing and brush and shaving. Unnecessary water was being wasted for feet wash.

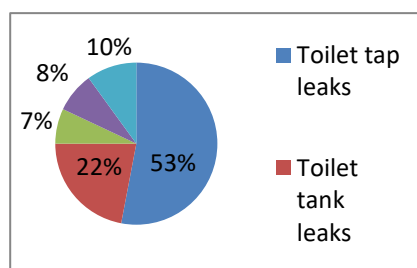
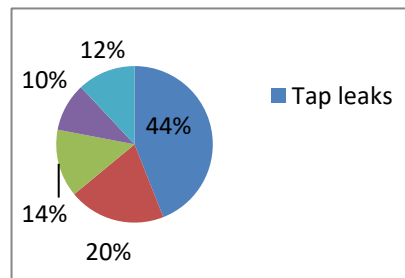


Figure 1

Wastage During Washing

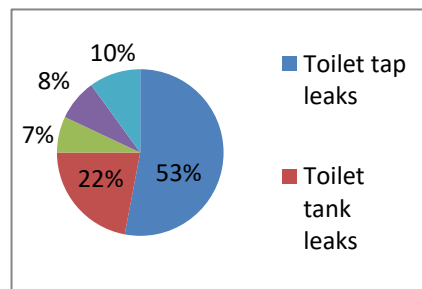
Tap leaks accounted for the maximum leakage (Fig. 2) followed by overflow of taps due to not-turning off. The missing taps contributed towards maximum water loss. At few places underground pipe leakages were also detected.

**Figure 2**

Leakages in Parks

3.2. Leakages in public hospital toilets

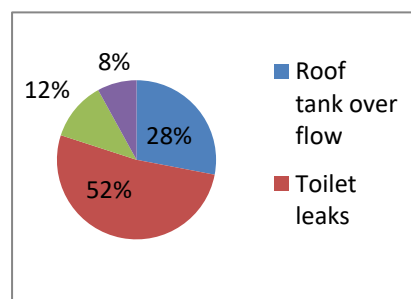
It was found public hospitals were in a pitiable state (Fig. 3). Most of the taps were leaking, flush tanks were broken, drain pipes were missing, which contributed towards water wastage.

**Figure 3**

Leakages in Public Hospital Toilets

3.3. Leakages in shopping areas

Walk-in water audit of shopping areas reveal (Fig. 4) that maximum leaks were in public toilets followed by roof tank overflows. A small percentage of taps is found satisfactory.

**Figure 4**

Leakages in Shopping Areas

3.4. Leakages in schools/ colleges/ universities

A large number of toilets/ taps were in satisfactory condition. Some leaks were found due to non-turning off/ mismanagement.

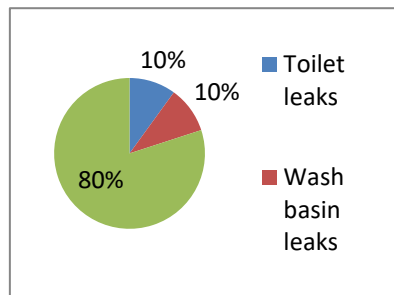


Figure 5

Leakages in Schools/ Colleges/ Universities

4. DISCUSSION

1. Sub-metering can propel the proper management of water. Sub-meters should be installed on individual zones or floors of the facility. The meter readings should be lodged and reviewed on a regular basis for unexplained changes. This way, the consistent tracking of water meter readings will provide a baseline of water use for the facility.
2. The maintenance of practice must be reviewed regularly. Drafts of water efficiency plans are important. The plans must be measurable and achievable and realistic.
3. The water efficiency plan should be followed. The plan should set specific water use reduction goals for the facility. Those goals must be measurable, achievable and realistic. The plan must also identify a mechanism for periodically reviewing the success of the program in meeting those goals.
4. All source meters must be verified annually.
5. Public supply should be required to perform periodic water audits. The government must perform periodic water audits on public supply.
6. Graph the monthly or bio-monthly usage for the last two years. A pattern will seem to emerge. Tenants tend to shower more during the summer. Landscaping may require more water during warmer months as well.^[14] Monitoring of monthly or bi-monthly usage must be done. A simple bar graph will show that there is a pattern.
7. If one suspects a leak, the water meter must be checked. It is best to check the meter when the water is off, so one will most likely need to serve notice that one is shutting the water off for a short period of time, about 30-60 minutes.^[15]
8. The concept of data lodging is helpful for identifying leaks. Data lodging involves a flow record. A flow record is attached to the meter and the data is lodged at regular intervals throughout the day over the course of a week. Water flow rates will vary during the day, but usually fall drastically during the wee hours of the morning.^[15]
9. It is important to check all toilet flappers and diaphragms. Use dye tablets to test for leaks. Remember chlorine tablets destroy toilet flappers. This should also be on your annual inspect list along with checking the units smoke detectors. Homeowners Associations may wish to initiate a pro-active maintenance program.^[15]
10. Check for leaks among the irrigation heads of your sprinkler system for boggy spots.^[15]
11. Conducting a water audit at home can be done by taking meter reading and calculating water usage before implementation, check for leaks, install thimbles, practice and share good water saving habits with family members, take meter reading and calculate water savings after implementation.^[16]
12. Heavy fines/ liabilities should be imposed on institutions/ individuals wasting water.
13. Awareness campaigns for all sections of the society should be undertaken frequently.

5. CONCLUSION

Reducing water use in an institution is not only environment friendly but also economically viable. Using less water means lower utility costs. In turn there are reduced chemical treatment costs in systems such as boilers and cooling towers. Finding and eliminating long-standing leaks can create a better work environment for building occupants, as well as reduce damage to building

components. Reducing water use can also enhance the public image of institution. Incentives must be provided to those who publicize water conservation campaign. Statutory amendments and new legislations are required to be introduced by the government to curb water theft and wastage of water. Irrigation system can improve the water use. It was observed that mostly public sector building, households, parks, etc. were found to have leakages and under maintained water system whereas private sector counterparts had minimum or no complaints. Public at large was receptive to recommendations and awareness campaign.

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